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The point is, therefore, the center of mean position of the  $n$  points as stated.

Also solved by J. Scheffer.

264. Proposed by W. J. GREENSTREET, M. A., Stroud, England.

The join of the center of curvature of a curve to the origin is at  $a$  to the initial line. Prove that with the usual notation:

$$\frac{d a}{d \psi} \left[ \left( \frac{d p}{d \psi} \right)^2 + \left( \frac{d^2 p}{d \psi^2} \right)^2 \right] = \frac{d p}{d \psi} \cdot \frac{d \rho}{d \psi}.$$

No solution of this problem has been received.

265. Proposed by V. M. SPUNAR, M. and E. E., East Pittsburg, Pa.

Find two curves which possess the property that the tangents  $TP$  and  $TQ$  to the inner one always make equal angles with the tangent  $TT'$  to the outer.

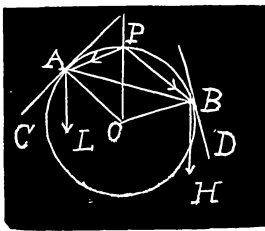
No solution of this problem has been received.

### MECHANICS.

219. Proposed by W. J. GREENSTREET, M. A., Stroud, England.

A rod length  $a\sqrt{3}$ , weight  $W$ , has at each end a smooth ring which can slide on a vertical circle radius  $r$ . Each ring is attached by an elastic string (natural lengths  $a$ ,  $b$ ; moduli  $\mu a$ ,  $\mu b$ ) to the highest point of the circle. Find the inclination of the rod to the horizon in a position of equilibrium.

Solution by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.



In what follows we regard the strings as having no weight, and also that both strings are in tension from the weight of the rod and rings, and the rod is above the center of the circle. Let  $AB = a\sqrt{3} = \text{rod}$ ;  $AP = \text{string } a$ ;  $BP = \text{string } b$ ;  $O$ , the center of the circle, radius  $AO = r$ . Draw  $AK$  perpendicular to  $PO$ . Let  $m = \text{weight of each ring}$ ;  $\angle AOB = \beta = 2\sin^{-1}(a\sqrt{3}/2r)$ ;  $\angle APB = \pi - \frac{1}{2}\beta$ ;  $\angle KAB = \theta = \text{angle } AB \text{ makes with the horizon}$ ;  $\angle PAB = \phi$ ;  $\angle PBA = \frac{1}{2}\beta - \phi$ ;  $T = \text{tension of string } AP$ ;  $T' = \text{tension of string } PB$ . When in equilibrium,  $W$  and the components of  $T$ ,  $T'$  tangent at  $A$ ,  $B$  meet in a point.  $AP = a(1 + T/\mu a) = (\mu a + T)/\mu$ ,  $BP = (\mu b + T')/\mu$ ,  $T = (\frac{1}{2}W + m)\sin(\phi - \theta)$ . Let  $(\frac{1}{2}W + m) = Q$ .  $\therefore T = Q\sin(\phi - \theta)$ ,  $T' = Q\sin(\theta + \frac{1}{2}\beta - \phi)$ ,  $AP/PB = (\mu a + T)/(\mu b + T') = \sin(\frac{1}{2}\beta - \phi)/\sin \phi \dots (1)$ .

$$3\mu^2 a^2 = (\mu a + T)^2 + (\mu b + T')^2 + 2(\mu a + T)(\mu b + T')\cos \frac{1}{2}\beta \dots (2).$$

The values of  $T$  and  $T'$  in (1) and (2) give

$$[\mu a + Q\sin(\phi - \theta)]\sin \phi = [\mu b + Q\sin(\theta + \frac{1}{2}\beta - \phi)]\sin(\frac{1}{2}\beta - \phi) \dots (3).$$